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CITY OF EMERYVILLE

GENERAL PLAN

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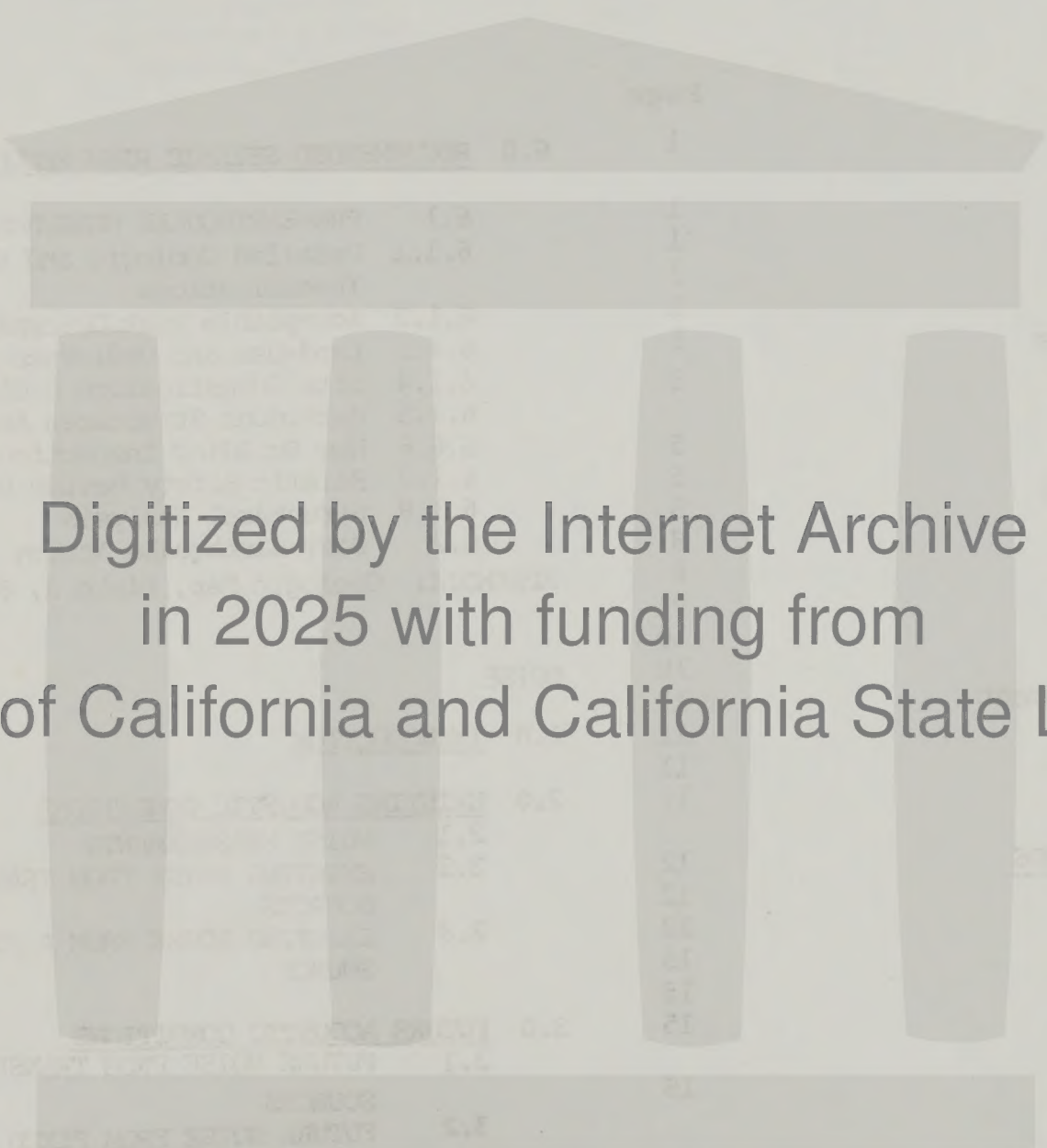
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SEISMIC SAFETY ELEMENT

1.0 INTRODUCTION

The purpose of the Seismic Safety Element is to identify and appraise potential seismic hazards in the City of Emeryville in such a way as to enable the City to account for these hazards in its planning programs and development plans.

2.0 GEOLOGIC SETTING

2.1 REGIONAL GEOLOGY

The City of Emeryville is situated in the central portion of the Coast Range Mountains; this mountain range extends from the California-Oregon Border to the Transverse Range Mountains in Southern California. Extensive folding and faulting has produced the northwest-trending valleys and mountain ranges which are characteristic of the Coast Range geomorphic province. The regional rock units are shown on Plate 1, Generalized Geologic Map of the San Francisco Bay Area Counties. The oldest rocks in this portion of the Coast Range mountains consist of Jurassic-Cretaceous rocks (sandstone, metamorphics, and granitic rocks) deposited 65 to 190 million years ago. Tertiary sediments, consisting predominantly of sandstones, shales, siltstones, conglomerates, and volcanic rocks, overlie the older Jurassic-Cretaceous bedrock. These tertiary rocks were deposited between 3 and 65 million years ago and have undergone repeated episodes of deformation by folding and faulting within the last 3 million years.

Uplift of the hills surrounding the San Francisco Bay by faulting and folding contributed to rapid erosion and deposition of a thick sequence of poorly consolidated alluvial fan deposits. Fluctuation in sea level, as a result of continental glaciation, also accelerated the erosion-deposition process. Water level in San Francisco Bay may have receded by as much as 300 feet below its present level three times within the last 2 Million years (Quaternary time).

During periods of rising sea levels, meltwater from the Sierran glaciers deposited considerable amounts of silt and clay size particles in the trough occupied by San Francisco Bay; these deposits are known as "bay mud". Younger bay mud deposits, up to 130 feet thick in some portions of the Bay, accumulated during the last 10,000 years.

2.2. LOCAL GEOLOGY

The City of Emeryville consists of about 750 acres of relatively flat topography adjacent to San Francisco Bay and 700 acres of water-covered bayland. There are no exposed rock outcrops, and the area is almost entirely developed and urbanized. Therefore, most of the geologic data are inferred from the regional geology.

2.2.1 Bedrock

Little is known of the bedrock in Emeryville area since it is covered by as much as 600 feet of alluvial deposits. It is assumed, from the regional geology, that the bedrock consists of sandstones and shales of the Franciscan Assemblage (Jurassic-Cretaceous Age).

2.2.2 Quaternary Deposits

As much as 540 feet of older Quaternary sediments may overlie the bedrock in the Emeryville area. These older deposits are covered by more recent surficial material, and their characteristics must be inferred from the regional geology and limited boring log data. In general, these deposits consist of poorly consolidated, interbedded silts, sands and gravels, known as the Alameda Formation (QA).

2.2.3 SURFICIAL DEPOSITS

Older Alluvial Fan Deposits: Older alluvial fan deposits (Qof) are exposed in the southeastern portion of the City. They consist of weakly consolidated, poorly-sorted sands, silts, clays, and gravels up to several hundred feet thick. These deposits include sediments within the Alameda and Temescal formations.

Temescal Formation: Temescal formation (Qtc), consisting of younger fluvial deposits (Qyfo), and interfluvial basin deposits (Qb), constitute the predominate exposed surficial deposits in this area. Their distribution is shown on Plate 2, Geologic Map.

The Younger Fluvial or stream deposited sediments (Qyfo) consist of unconsolidated fine sand, silt, and silty clay which may be in part windblown. These deposits are generally less than 15 feet thick.

Interfluvial Basin Deposits (Qb) are deposited in depressions or poorly drained areas adjacent to the bay. They consist of poorly sorted, organic-rich, plastic clay and silty clay. In general, these sediments are less than 10 feet thick.

Merritt Sand: Trask and Ralston (1951) show a continuous sand-clay layer of Merritt Sand, 30 feet thick, beneath 10 to 20 feet of bay mud, located in the bay north of Powell Street and extending from the shoreline to about 1,800 feet into the bay. Merritt Sand is generally unconsolidated and consists of fine-grained (average 163 microns in diameter), well-sorted beach and windblown sands. These sands grade laterally into the Temescal Formation. The maximum thickness of these deposits south of the City of Emeryville is 65 feet. This sand was a main source of borrow material used for bay fill during construction of the Bay Bridge crossing.

Bay Mud: Younger bay mud (Qbmy), whose origin is discussed under Section 2.1, consists of a soft, plastic, generally unconsolidated silty clay with a water content of 100% or more. It is a poor foundation material due to its low strength, high compressibility, expansive characteristics, and tendency toward differential settlement. Minor amounts of sand, gravel, peat and shell fragments are found interbedded within the bay mud, especially in the vicinity of drainage outlets and sloughs. Up to 60 feet of younger bay mud occurs in this area (U.S. Army Corps of Engineers, 1963); see Plate 2. Underlying the younger bay mud is an undetermined thickness of older, more consolidated bay mud.

Artificial Fill: Since the late 1800's the Emeryville shoreline has been progressively extended baywards by artificial fill. Approximately one-third of the land area of the City presently consists of fill placed over bay mud. The composition of the fill is highly variable, but in general it appears to consist of imported clayey and/or sandy soils combined with construction and industrial waste materials.

Indian Shell Mound: A shell mound accumulated by the Costanoan Indians is located along the bayfront just north of the Temescal Creek outlet, as shown on Plate 2. This is a relatively large shell mound, being 1,000 feet in length, 300 feet in width, and originally extending 22 feet above the ground surface (Heizer, 1951). Radiocarbon age dating of charcoal found near the base of this shell mound, about 8 1/2 feet below the present ground level, indicates that the mound is 2,310 years old (accurate to within 220 years).

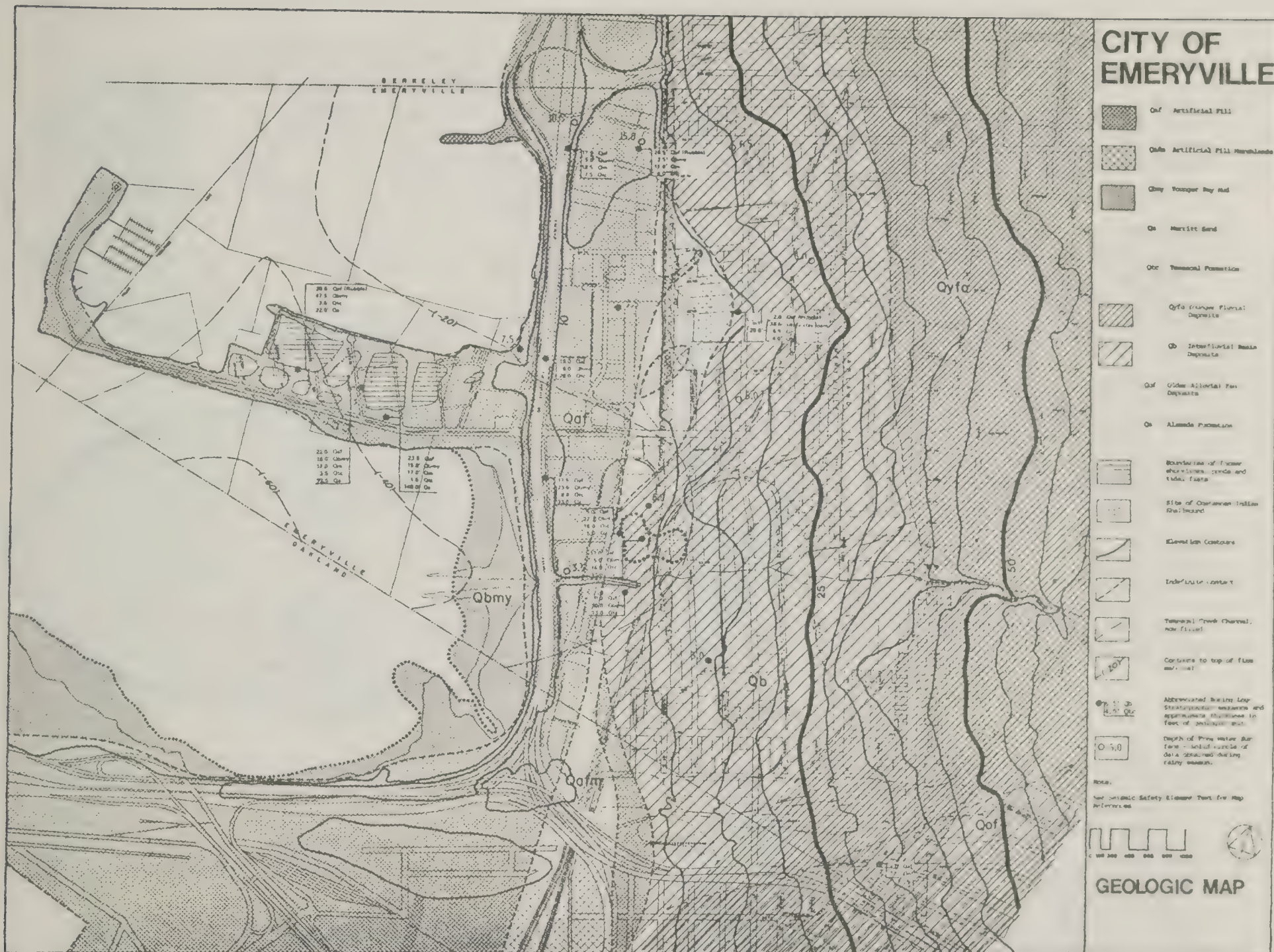


Plate 2

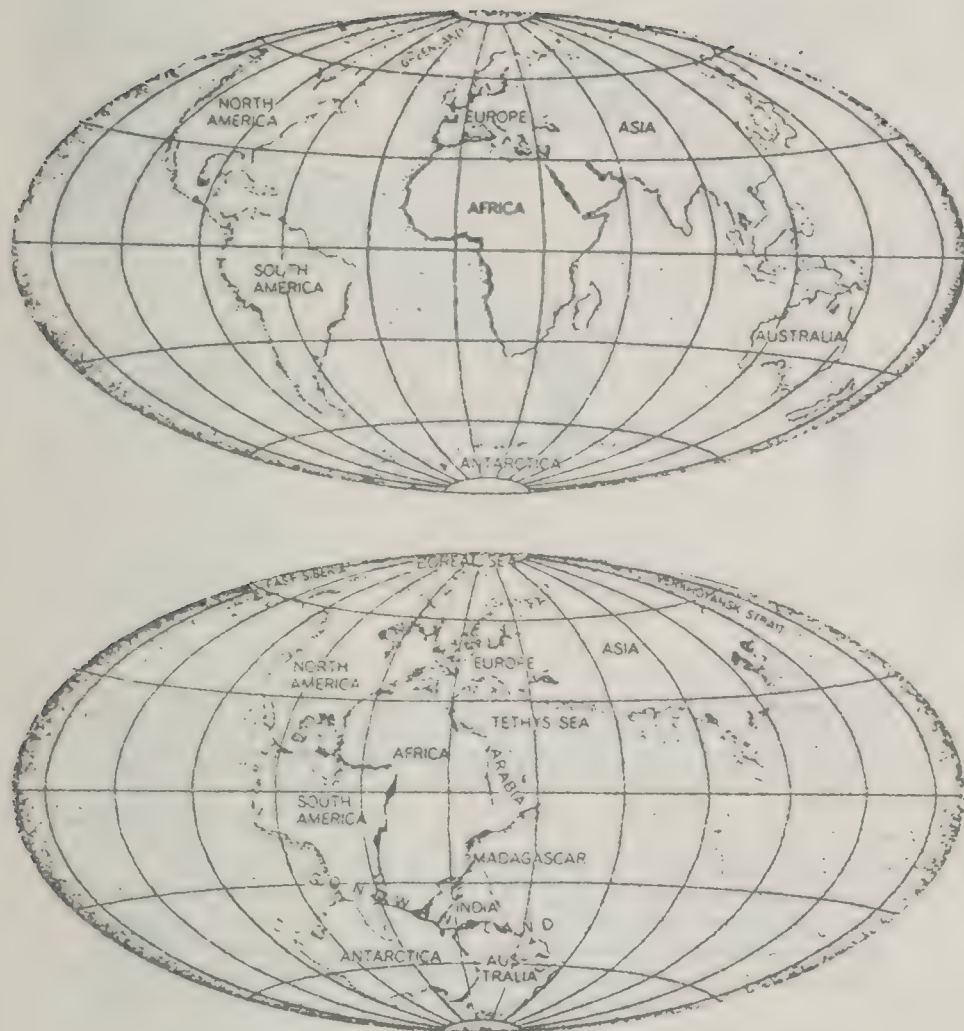


FIGURE 1
MOVEMENT OF CONTINENTAL PLATES

The top map shows the present configuration of the continents. The bottom map shows the single supercontinent as it may have been some 150 million years ago.

REF: Wilson, T.J., 1963, Continental drift: Scientific American, Vol. 208, No. 4, p. 86-100.

3.0 SEISMICITY

3.1 GLOBAL SEISMICITY

Seismicity in the study area can best be understood in terms of its relation to the pattern of global seismicity, which included the theory of plate tectonics.

The surface layer of the earth is a relatively rigid crust which ranges from 15 to 40 miles thick beneath the continents and 5 1/2 miles or less thick beneath the ocean basins. Beneath this rigid crust is the earth's semi-solid mantle. Recent studies indicate that approximately 200 million years ago most of the existing continents of the world were joined together as a single supercontinent, located in the vicinity of present day Africa, as shown on Figure 1, Movement of Continental Plates. About 150 million years ago, this supercontinent broke into large blocks or plates with the North American block drifting westward, "floating" on the semi-solid mantle material. The continent is still moving, and it is this slow drift which produces the earthquakes which are most pronounced along its leading or western edge, as indicated on Figure 2, Earthquake Belts of the World.

3.2 REGIONAL SEISMICITY

The site's location with respect to major active or potentially active faults is shown on Plate 3, Epicenters of Moderate and Major Historic Earthquakes and Active, Potentially-Active Faults in the San Francisco Bay Area. Strong, destructive earthquakes have originated within historic times along the Hayward, San Andreas, and Concord-Green Valley Faults, which are located 3 1/2, 15 and 16 miles, respectively, from the City of Emeryville.



Most of the world's earthquakes occur in a number of vast, near-continuous, seismically active "belts" that coincide with zones in which mountain-building processes are still taking place. About 80 percent of all earthquakes, as well as most of the world's active volcanoes, occur in the so-called "Ring of Fire" surrounding the Pacific Ocean, following in a general way the border between continents and oceans.

Earthquakes and volcanic eruptions have been taking place for more than 4 billion years, and will continue as long as the earth exists. It is estimated that 3 to 5 million lives have been lost in the past 1,000 years from earthquakes and volcanoes. Records of past events indicate that a catastrophic earthquake, with energy equivalent to that of thousands of atomic bombs, will strike the earth about once a year. With the world's population expected to double in another 40 years, many major cities are increasingly vulnerable to earthquake hazards.

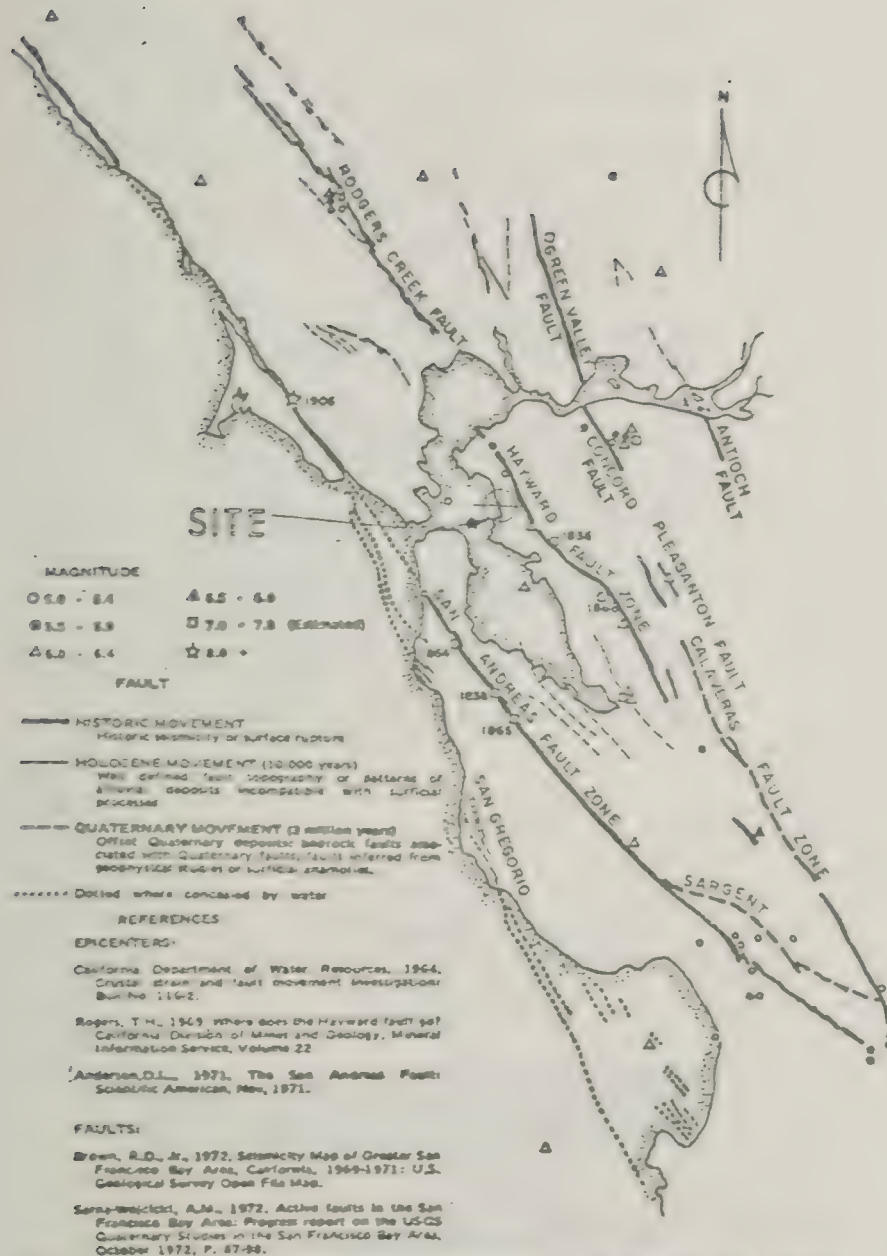
It is not yet possible to make "pinpoint" predictions of earthquakes. However, earthquake research efforts have been intensified, and special studies of such earthquake-prone zones as the San Andreas Fault in California by geologists, geophysicists, and seismologists of the U.S. Geological Survey's National Center for Earthquake Research, are yielding new insights into the mechanics of earthquakes and, hopefully, may make earthquake predictions possible. In addition, engineering geology studies designed to determine the properties and distribution of earth materials which may react unfavorably under seismic conditions will increase man's ability to live safely in earthquake zones.

FIGURE 2
EARTHQUAKE BELTS OF THE WORLD

Approximately 19 major earthquakes have shaken this area over the past 138 years. A tabulation of these earthquakes is shown on Table 1, Earthquakes with Modified Mercalli Intensities Above V. A record of damage in the Emeryville area as a result of these earthquakes is unavailable. This lack of information may be due to the low population density and industrial nature of the City. However, if major damage had occurred it no doubt would have been recorded. The relationship between the more commonly used Richter Magnitude Scale and the Modified Mercalli Intensity Scale is given on Plate 4.

An 8.3 magnitude earthquake occurred along the San Andreas Fault in 1906, and in 1968 a $7 \pm$ magnitude earthquake occurred along the Hayward Fault. Both faults moved presently "creeping" or "slowly moving", about 1/4 inch per year. This slow movement is believed to release the built-up stresses in the rocks and thereby lessen the magnitude of a future earthquake. On the other hand, the San Andreas Fault appears to be locked in place from Hollister northward. The progressively built-up stresses along this "locked in" portion of the fault may some day be released, as in 1906, by a violent earthquake. Major movements along either of these active faults would very probably produce significant ground shaking within the City of Emeryville.

The recurrence interval for magnitude 6, 7 and 8 earthquakes occurring in the bay area has been estimated by various methods. The National Oceanographic and Atmospheric Administration's estimates are based on statistical analysis of historical data, somewhat similar to the analysis used in estimating the return period of floods. Their findings are summarized on Table 2, Earthquake Recurrence Interval for the Bay Area.



EPICENTERS OF MODERATE AND MAJOR HISTORIC EARTHQUAKES AND ACTIVE, POTENTIALLY-ACTIVE FAULTS IN SAN FRANCISCO BAY AREA, CALIFORNIA
 PERIOD COVERED: 1836 to 1972

Scale 0 10 20 25 Miles

Plate 3

Date	Fault	Maximum Intensity (M.M.)	Magnitude (Richter)
10 June 1836	Hayward	X	---
? June 1838	San Andreas	X	---
15 May 1851	?	VI?	---
15 February 1856	Hayward	VIII+	---
26 November 1858	Hayward or Calaveras	VIII-IX	---
3 July 1861	Calaveras?	VIII?	---
5 March 1864	Hayward-Calaveras?	VII+?	---
8 October 1865	San Andreas	IX-X	---
21 October 1868	Hayward	X+	---
25 March 1884	San Andreas?	VI	---
19 April 1892	Midland?	IX	---
30 March 1898	Mare Island?	VIII+	---
2 August 1903	Hayward	VIII+	---
18 April 1906	San Andreas	X+	8.25
1 July 1911	Hayward	IX	6.6
7 October 1915	Hayward	VI	---
8 March 1937	Hayward	VII	4.5
23 October 1955	Calaveras	VII	5.4
22 March 1957	San Andreas	VII	5.3

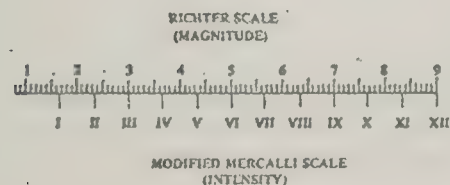
Data from Townley and Allen (1939) and U.S. Department of Commerce (1928-1970).

Ref: California Division of Mines and Geology Preliminary Report 19.

TABLE 1
 EARTHQUAKES WITH MODIFIED MERCALLI INTENSITIES ABOVE V

MODIFIED MERCALLI INTENSITY SCALE OF 1931

I	Not felt except by a very few under especially favorable circumstances.
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated.
IV	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles and other tall objects sometimes noticed. Pendulum clocks may stop.
VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Disturbs persons driving motor cars.
IX	Damage considerable in specially designed structures; well designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with their foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (stopped) over banks.
XI	Few, if any (masonry), structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII	Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.



The intensity scale is subjective and based on ground motion and degree of damage. It depends upon the strength of the earthquake, distance from the epicenter and local geology. Magnitude of an earthquake is measured on a seismograph and defined as the logarithm of the amplitude of the motion recorded at a distance of 100 kilometers from the epicenter. The limiting factors involved in comparing these two scales include the effect of local geology, depth of soil, earthquake focal depth, and duration of shaking.

RELATIONSHIP BETWEEN MAGNITUDE AND INTENSITY SCALES

Plate 4

3.3 LOCAL SEISMICITY

3.3.1. Ground Shaking

The effects of a major earthquake on the City of Emeryville would be manifested by severe ground shaking. Ground shaking is the oscillation or vibration of earth materials resulting from an earthquake. It is the most commonly experienced earthquake phenomenon, because it may be felt many tens or even hundreds of miles from the earthquake epicenter.

The severity and type of ground shaking and its impact on structures depend on several factors, including:

1. Magnitude of the earthquake.
2. Depth of focus.
3. Distance from causative fault.
4. Duration of shaking.
5. The local soil/groundwater conditions.
6. The relationship between the fundamental period of a structure and the predominant period of ground vibration.
7. The design of the building or structure.
8. The workmanship and quality of materials used during construction.

Magnitude (Richter)	Intensity (M.M.)	Estimated Return In Years
6	VII	17
7	IX	32
8.3	XI	170

Table 2: Earthquake Recurrence Interval for the Bay Area

Source: Algermissen, et al. (1972)

Evidence has shown that ground shaking generally causes greater damage in areas underlain by loose, water-saturated materials than in areas underlain by competent rock. Such behavior has been repeatedly and strikingly demonstrated by large earthquakes, including those in San Francisco, 1906; Tokyo, 1923, Fukui, 1948; Arvin-Tehachapi, 1952; Chile, 1960; and Alaska, 1964.

Rock motions near the causative fault during major earthquakes generally have predominant periods of 0.2 to 0.5 seconds. The predominant period increases as the distance from the causative fault increases and/or as the motions propagate through thick alluvium which may increase the predominant period by several seconds. In addition to generally modifying the predominant period of the underlying bedrock, alluvial deposits also may change the amplitude, acceleration, and velocity of the motion.

Investigations conducted by Woodward-Lundgren and Associates (1971) in the Emeryville area, state that for earthquakes of less than magnitude 5 1/2, the soil profile near the Watergate Development will amplify bedrock accelerations from 1 to 2 times, but for earthquakes greater than magnitude 7, the soil profile will attenuate the bedrock accelerations.

3.3.2 Liquefaction

Water - saturated granular soils may lose all shear strength and assume the characteristics of a heavy liquid when subjected to intense or prolonged ground vibrations. Soil liquefaction occurs as a result of the soils tendency to compact under ground shaking vibrations.

Liquefaction is a rather common phenomenon during major earthquakes, and it has caused severe damage to structures on level ground as a result of settling, tilting, or floating. Many structures settled 3 feet or more and one structure tilted 80 degrees from the vertical during the 7.5 magnitude 1964 earthquake in Niigata, Japan (Wiegel, 1970).

If liquefaction occurs in or under a sloping soil mass, the entire mass may flow or translate laterally toward a lower elevation. A typical example of this type of slide occurred along the coastline near the town of Seward during the 1964 Alaskan Earthquake. The slide involved some 4,000 feet of coastline which moved toward the sea during the earthquake.

Numerous landslides in clayey soils have occurred as a result of thin sand layers liquefying within the clay mass. Liquefaction of such layers reduces the shear strength of the sand and causes reduction in the strength of the surrounding clayey soils due to induced pore-water pressures.

In addition to liquefaction of natural soils, liquefaction can also occur in hydraulically-placed sand fills and loosely-dumped fills.

The most significant factors in determining susceptibility to liquefaction are: grain size distribution, relative density, confining pressure, number of significant loading cycles, and maximum ground acceleration. Saturation of the granular soils assumed. The inter-relationship of the five factors mentioned above is extremely complex.

Grain Size: In general, silts and fine sands have the highest liquefaction potential. As the mean grain size increases from fine sand to coarse gravel, the liquefaction potential tends to decrease. Similarly, as the percentage of clay size particles increases the liquefaction potential decreases.

Relative Density: Relative density is a measure of the looseness of granular soil deposits. Relative density should not be confused with compaction (percent compaction). The more dense the soil, the less likely it is to liquefy. Direct determination of the relative density of saturated in-situ granular deposits is extremely difficult. Most soil sampling methods cause some disturbance, with consequent changes in relative density. Indirect measurement using the Standard Penetration Test (a test which measures the number of blows required to drive a specified sampler 12 inches into the ground with a specified hammer) is the most common method for determining in-situ densities. Correlating standard penetration test blow counts with laboratory minimum-maximum density tests provides an approximation of relative density.

Confining Pressure: The confining pressure is the pressure applied to the granular deposits by overlying materials. This pressure increases with depth below the ground surface, with increased depth to groundwater level, and as a result of man-made loads, such as extensive fills. In general, the potential for liquefaction decreases as the confining pressure increases.

Number of Significant Stress Cycles: The number of significant stress cycles is related to the duration of

an earthquake. The oscillating nature of the ground shaking induced by earthquakes causes repeated cycles of stress application to the granular deposits. As the number of such significant cycles increases, the potential for liquefaction also increases.

Maximum Ground Acceleration: The maximum ground acceleration is related to earthquake magnitude, depth to bedrock, distance from the causative fault, local soil conditions, and other factors.

Other Factors: Susceptibility to liquefaction is also influenced by frequency, amplitude, and period of vibration.

Other forms of ground failure include: earth lurching, lateral spreading, and differential settlement.

3.3.3 Earth Lurching

Earth lurches are distinctly earthquake-related. Lurching involves earth motion at right angles to a cliff or, more commonly, to a stream bank or artificial embankment. Such motions cause a series of more or less parallel cracks separating the ground into rough blocks. Lurching accompanied by soil liquefaction may eject sand and groundwater from the cracks. Earth lurching can also produce permanent undulations or waves on soft soils. The 1906 San Francisco Earthquake produced undulations up to 3 feet high in the ground surface (Lawson, 1908).

3.3.4 Lateral Spreading

Lateral spreading occurs in soft saturated clays, such as younger bay muds and lagoon deposits. During ground shaking, these soft

materials may flow or squeeze laterally toward an unretained side. This type of ground failure can also occur beneath fills, with the fill developing severe longitudinal cracks.

3.3.5 Differential Settlement

Loose to medium dense granular soils tend to compact during ground shaking, often causing significant settlements. If such settlements were uniform beneath a given structure, damage would be minimal. However, density variations, confining conditions, and irregular ground shaking tend to cause irregular settlement which often produced serious structural damage. Settlements can occur in dry and partially saturated as well as in fully saturated granular soils.

Steinbrugge (1968) believes that pre-earthquake differential settlements induce stresses in a building which may precondition the building for added structural damage in the event of an earthquake. Therefore, seismic damage to structures on filled land which have been subject to static differential settlement could be greater than on natural ground.

3.3.6 Surface Rupture

Earthquakes are usually generated by movement along fault planes or by volcanic activity. Surface rupture occurs during an earthquake when fault displacement extends upward and intersects the ground surface. However, surface rupture does not occur every time a fault moves.

The length of surface rupture occurring along a fault trace, the width of the zone of surface rupturing, and the amount of displacement between opposite sides of the fault at the surface during a single earthquake are highly variable. These factors are believed to be related to the length of the fault. Studies have

shown that the longer the active fault, the greater the potential for a high magnitude or great earthquake, and the greater the possibility that a large amount of surface displacement will occur. The greatest displacement during a single earthquake documented in California occurred along the Owens Valley fault during the 1972 earthquake, when 23 feet of movement occurred.

3.3.7 Tsunamis

Tsunamis, or seismic sea waves, are long-period waves usually caused by an underwater seismic disturbance, volcanic eruption or, less commonly, by large submarine landslides. The waves may be only one to two feet high as they travel across the ocean at a speed of several hundred miles an hour. However, due to frictional resistance in the shallower waters, the tsunami waves may increase in height to tens of feet as they approach the coastline.

3.3.8 Seiches

Seiches are water waves within an enclosed or restricted body of water such as a lake, bay or reservoir. The effect of seiches upon a water basin is analogous to the sloshing of coffee in a cup. These waves can be generated by changes in atmospheric pressure, wind and earthquakes. Wave height is amplified when the natural frequency of the water body coincides with the frequency of the causative force (e.g., ground shaking).

4.0 EMERYVILLE'S SEISMIC HAZARDS

4.1 GROUND SHAKING

The hazards due to severe ground shaking are well known. The effect of ground motion on buildings depends not only on the characteristics of the ground motion, but also on the height and type of buildings. The fundamental periods for a typical single-story building, 10-story building and 40-story building are on the order of 0.1, 1.0, and 4.0 seconds, respectively. Ground motions may have predominant periods of several seconds when they reach the surface of soft soils. If a building is subjected to a series of vibrations having the same period as its fundamental period, large amplitude motions and internal stresses develop. On the other hand, if the same building is subjected to base vibrations having a period very different from its fundamental period, generally comparatively small effects will be induced. Assuming that other ground motion characteristics are the same, a low, rigid, short-period structure would be more heavily damaged on firm ground, and a tall, flexible, long-period structure would be more heavily damaged on deep unconsolidated material. Accordingly, it is desirable to develop as great a difference as possible between the fundamental period of a building and the predominant period of the anticipated ground motion. The predominant period of the ground is determined by dynamic ground response studies based upon the characteristics of the alluvium and anticipated bedrock motions.

Hypothetical bedrock motions which have been proposed for earthquakes in the vicinity of Emeryville are shown on Plate 5, Hypothetical Rock Motions.

4.2 LIQUEFACTION

Boring logs from the Emeryville area indicate that the City is underlain by variable layers of poorly consolidated silts, sands and gravels located within 50 feet

Fault	Hayward	Concord (Green Valley)	San Andreas
Maximum Magnitude ¹	6 - 7.5	6 - 7	7 - 8.5
Maximum Duration of Shaking (sec) ²	10 - 40	10 - 25	15 - 60
Maximum Intensity ³ (M.M.) in Emeryville	IX - X	VIII - IX	VIII
Peak Bedrock Acceleration at Emeryville ⁴	.3g	.3g	.45g
Significant Cycles of Seismic Loading ⁵	10 - 20	10	10 - 30

1. Estimates based on historic seismicity of the fault (Townley and Allen, 1939), behavior of faults of similar length (Tocher, 1958; Lida, 1965; Albee and Smith, 1967; Bonilla, 1967; Bonilla and Buchanan, 1970), and, where available, geologic history of displacement.
2. Estimate based on records of the duration of shaking of historic earthquakes (Page, et al., 1972, U.S. Geological Survey Circular 672).
3. Estimates based on records of the intensity of shaking associated with historic earthquakes.
4. Estimates based on "Soil Investigation for Watergate High Rise Office Tower, Phase I, Emeryville, California", Woodward-Lundgren & Associates, May 14, 1971.
5. The number of significant stress cycles is a function of earthquake magnitude. Table values follow relationship suggested by Seed and Idriss (1970).

HYPOTHETICAL ROCK MOTIONS
EMERYVILLE, CALIFORNIA

Plate 5

of the ground surface. These granular soils, combined with a shallow water table (generally less than 10 feet below the ground surface), make this area highly susceptible to ground failure by seismically induced soil liquefaction.

Artificial fills placed over bay mud are also prone to loss of strength and failure by liquefaction during a major earthquake.

Other forms of ground failure associated with liquefaction, such as earth lurching, lateral spreading, and differential settlement are likely to occur within localized lenses of water-saturated granular soils in the Emeryville area. Plate 6, Potential Seismic Damage Zone Map, delineates the general areas where seismic damage might have a significant impact.

Estimates on potential displacement are beyond the scope of this study. However, Wallace, Phillips, Drake and Boggs in their Report of Committee on the effects of the 1906 San Francisco Earthquake on railway embankments (American Society of Civil Engineers, Proc. Vol.33) provide some insight into the possible types of damage which could be expected on filled land adjacent to the bay. They state:

Embankment across marshes, or with soft strata underlying them, settled more or less. In some cases the settlement was vertical; in other cases there was considerable horizontal with the vertical movement.

At one point on the marsh between Benicia and Suisun on the Southern Pacific, the settlement was 11 ft.; at another point, 5 ft. These were nearly vertical.

Between Niles and San Jose, on the Southern Pacific, there was at one point a displacement of 3 ft. horizontal, but the vertical displacement was only 6 in.

On the North Shore, about 2 miles north of Point Reyes, the road, originally, had been constructed with pile trestles across several arms of Tomales Bay; these trestles had been filled about 15 years ago, the roadbed being about 8 ft. above ordinary high tide. Two of these embankments, 2,200 ft. and 900 ft. long, respectively, sank until the water at high tide washed over the rails.

Settlements of this character, and of more or less severity, were common on all railroads operating about the Bay of San Francisco and its tributaries.

Non-seismically induced landslide and mudflow hazards are not considered a hazard in the Emeryville area due to the relatively flat topography and urban improvements.

4.3 SURFACE RUPTURE

Surface rupture occurs when fault displacement extends upward and intersects the ground surface.

Available data indicate that there are no active faults beneath the alluvium in the vicinity of Emeryville. However, a presently unidentified fault may exist concealed beneath the thick (as much as 600 feet) alluvial sediments.

The only indication that a northwest trending fault may be present in the bedrock beneath the City is by inference that a probable fault, concealed in the bay west of Point Richmond, continues southward (Blake, et al, 1974). The fault west of Point Richmond is based on the assumption that a fault contact exists between the greenstone exposed on Red Rock and the sandstone exposed on Point Rich-

CITY OF EMERYVILLE

This map indicates, in general, potential areas where seismically induced ground shaking due to a major earthquake or the San Andreas, Hayward or Concord Faults may result in ground failure. The qualitative zoning is based on the following factors: (1) the seismic hazard potential; (2) the geologic character of the site; (3) the type, size, and structural condition of the structure. The seismic hazard potential is based on the following factors:

The type and degree of investigation needed to estimate the potential seismic damage is relative to the seismic hazard and occupancy. In general, where the level of seismic hazard is relatively low as indicated in Plate 6, certain studies should be undertaken relative to the following areas:

ZONE A: Detailed investigation required to estimate the potential seismic damage to the structure and occupancy. Also, a preliminary investigation should be made to determine whether or not the specific site is in the appropriate zone or zones.

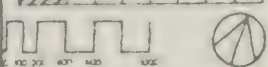
ZONE B: All of the above, plus sufficient geologic, seismic, soil and structural engineering analysis to safely determine the potential of the site relative to the occupancy and structural use. In general, it may be required to extend the investigation beyond the immediate vicinity of the proposed site in order to obtain the necessary data. Where faults are present, seismic investigations should be made to determine if setback requirements are necessary and, if so, the amount required.

ZONE C: All of the above, plus:

1. Subsurface surveys to evaluate liquefaction potential.
2. Foundation investigations to evaluate and estimate differential settlement potential.
3. Detailed fault and landslide investigations.

ZONE D: All of the above, plus dynamic ground and structure response and detailed structural analysis of any structures, if applicable.

POTENTIAL SEISMIC DAMAGE ZONE MAP									
Zone	1	2	3	4	5	6	7	8	9
Zone A									
Zone B									
Zone C									
Zone D									



POTENTIAL SEISMIC DAMAGE ZONE MAP

Plate 6

mond (Frizzell, U.S. Geological Survey, personal communication).

Additional evidence that this fault may continue southward is indicated by an aeromagnetic contour map of the bedrock which shows a slight depression in the magnetic contours along a southern projection of this probable fault (U.S. Geological Survey, 1970, Basic Data Contribution 23).

4.4 TSUNAMIS

During the period 1868 to 1969 a minimum of 19 tsunamis were recorded at the Golden Gate tide gauge. The maximum recorded wave height during that period was the tsunami generated by the 1964 Alaskan Earthquake, which registered 7.4 feet (Wiegel, 1970).

The tsunami generated by the 1964 Alaskan Earthquake entered San Francisco Bay and caused boats berthed at the Sausalito Marina to break their moorings and drift away. Other marinas in the main part of the bay were similarly affected, but to a lesser degree. It is not known if this tsunami was perceptible within the study area, since no damage was reported.

A map published by the U.S. Geological Survey in 1972 shows areas of potential inundation by Tsunamis within the San Francisco Bay (Ritter and Dupre, 1972). A 20-foot wave runup at the Golden Gate Bridge, with the tide stage at mean higher high water, was used to calculating areas which may flood. It is estimated this 20-foot wave will attenuate to a runup height of approximately 10 feet above mean sea level in the Emeryville area; frictional resistance and man-made structures would further reduce the on-shore distance or runup of this 10-foot wave. Therefore, the hazards related to inundation by this assumed maximum tsunami (M.S.L.) in the City of Emeryville.

Ritter and Dupre calculated that a tsunami having a wave height or runup of 20 feet may arrive at the Golden Gate once every 200 years. It should be pointed out that there is disagreement about these projected wave heights, with some authorities believing that they are too high. It is important to note that the Ritter and Dupre report was general in nature and that a more exact determination of tsunami damage potential would require more detail study. Further, the City Engineer reports that there is no recorded history of tsunami runup in Emeryville.

The potential for a locally generated tsunami generated by a strike-slip type of fault movement, characteristic of the major active faults in the San Francisco Bay Region, is remote. In fact, no significant fluctuation of sea level was noted at the Golden Gate tide gauge during the 1906 earthquake (Lawson, 1908).

4.5 SEICHES

There are no major dams or reservoirs in or adjacent to the Emeryville area which could develop hazardous seiches during a major earthquake.

5.0 SEISMIC HAZARDS

Plate 6 designates zones within the City of Emeryville which, based on geological and soils conditions, may experience intensive ground shaking and subsequent ground failures during a major earthquake. In general, ground failure in the Emeryville area would result from liquefaction, earth lurching, lateral spreading, and differential settlement within

localized areas. The possibility of damage from a tsunami is rather remote and would be limited to the area below Elevation 10 feet mean sea level.

6.0 RECOMMENDED SEISMIC RISK REDUCTION PROGRAM

The California Division of Mines and Geology, in their recently released publication "Urban Geology - Master Plan for California", estimates a total loss of 55 billion dollars by the year 2000 as a direct result of all seismic and geologic hazards. They further estimate that 38 billion dollars of this loss could be prevented by application of current state-of-the-art loss reduction measures. Reduction of these losses is not simple. It will require a concentrated effort on the part of City authorities and the cooperation of the community as a whole to implement effective pre-disaster and post-disaster measures. In order to reduce losses due to seismic activity the following program is recommended.

6.1 PRE-EARTHQUAKE MEASURES

To reduce hazards and losses related to seismic activity, comprehensive pre-earthquake studies should be undertaken and programs established. A list of suggested studies and programs is as follows:

1. Detailed geologic and seismic hazard investigations.
2. Acceptable risk determination
3. Land-use and ordinance review programs.
4. Site investigation ordinance.
5. Hazardous structures abatement programs.
6. New building inspection programs.
7. Establish a seismic safety review board.
8. Structural analyses.

The above studies and programs are listed in an approximate order of priority. However, it should be noted that several of the studies and programs can be conducted simultaneously. A more detailed description of the above listed studies and programs follows.

6.1.1 Detailed Geologic and Seismic Hazard Investigations

The first step in reducing the risk to life and property from seismic events is to accurately locate and evaluate potential seismic and geologic hazards. A general appraisal is presented in this report; however, much detailed work remains to be done for specific sites within the City limits. Such work would include a detailed review and appraisal of all boring logs ever made within the City.

Additional studies should be undertaken to determine the physical properties of the surficial soils, especially the thickness of unconsolidated alluvial deposits, depth to water table, gradation of the soils, and seismic response. This information, including the appraisal of existing boring logs, is very important in evaluating such earthquake-induced phenomena as liquefaction, differential settlement, lateral spreading and lurching. This information can, in part, be gradually accumulated by adopting a Data Bank in which existing geotechnical data are organized, indexed, and calculated.

Proposed major structures which have a high use, critical need, or a long-projected useful life, should have a dynamic seismic response analysis conducted as part of their pre-design studies. This analysis would evaluate the magnitude and effects of ground shaking, including the potential for ground failure. Once this information is developed, appropriated mitigating measures can be adopted.

6.1.2. Acceptable Risk Determination

Before any workable planning measures for the reduction of losses due to seismic activity can be undertaken, the level of acceptable risk

must be determined. Any undertaking contains some level of risk which must be balanced against the benefits to be gained. An acceptable risk versus benefit ratio depends, on the one hand, on the individual's choice and the nature of the risk, which can be described in terms of injury or loss of life and property and, on the other hand, on the resultant benefit. The public is willing to accept a higher degree of risk in activities in which they are allowed to choose whether they wish to participate. The risk of a leg broken while skiing may be acceptable, but it would not be acceptable when caused by a poorly designed or constructed stairway at school or work. For involuntary activities, the level of risk that the public is exposed to should be minimal.

Determination of what is an acceptable risk involves consideration of the following:

1. The type of risk (loss of life, injury or property loss).
2. The probability of the risk occurring.
3. Whether the people involved are voluntarily or involuntarily accepting the risk.
4. The costs involved to reduce the risk.
5. The benefits to be gained in reducing the risk.

Each of these factors must be considered if acceptable risk is to be evaluated. In regard to formulating acceptable risk policy, it has been observed that communities tend to accept higher risks prior to an earthquake than they do after an earthquake has occurred.

The ultimate decision regarding the level of acceptable risk rests with civic leaders. The task of engineers, geologists, and planners is to identify and classify the probable risk zones. A preliminary scale of acceptable risks has been published by the California Joint Committee on Seismic Safety and is included in this report as Plate 7, A Scale of Acceptable Risks.

Level of Acceptable Risk	Kinds of Structures	Extra Project Cost Probably Required to Reduce Risk to an Acceptable Level
1. Extremely low ¹	Structures whose continued functioning is critical, or whose failure might be catastrophic: nuclear reactors, large dams, power intertie systems, plants manufacturing or storing explosives or toxic materials	No set percentage (whatever is required for maximum attainable safety)
2. Slightly higher than under level 1 ¹	Structures whose use is critically needed after a disaster: important utility centers; hospitals; fire, police, and emergency communication facilities; fire stations, and critical transportation elements such as bridges and overpasses; also smaller dams	5 to 25 percent of project cost ²
3. Lowest possible risk to occupants of the structure ³	Structures of high occupancy, or whose use after a disaster would be particularly convenient: schools, churches, theaters, large hotels, and other high-rise buildings housing large numbers of people, other places normally attracting large concentrations of people, civic buildings such as fire stations, secondary utility structures, extremely large commercial enterprises, most roads, alternative or noncritical bridges and overpasses.	5 to 15 percent of project cost ⁴
4. An "ordinary" level of risk to occupants of the structure ^{5,6}	The vast majority of structures: most commercial and industrial buildings, small hotels and apartment buildings, and single family residences.	1 to 2 percent of project cost, in most cases (2 to 10 percent of project cost in a minority of cases) ⁷

¹ Failure of a single structure may affect substantial populations.

² These additional percentages are based on the assumption that the base cost is the total cost of the building or other facility when ready for occupancy. In addition, it is assumed that the structure would have been designed and built in accordance with current California practice. Moreover, the estimated additional cost presumes that structures in the acceptable-risk category are to embody sufficient safety to remain functional following an earthquake.

³ Failure of a single structure would affect primarily only the occupants.

⁴ These additional percentages are based on the assumption that the base cost is the total cost of the building or facility when ready for occupancy. In addition, it is assumed that the structures would have been designed and built in accordance with current California practice. Moreover, the estimated additional cost presumes that structures in the acceptable-risk category are to be sufficiently safe to give reasonable assurance of preventing injury or loss of life during and earthquake, but otherwise not necessarily to remain functional.

⁵ "Ordinary risk": Resist minor earthquakes without damage, resist moderate earthquakes without structural damage, but with some non-structural damage, resist major earthquakes of the intensity or severity of the strongest experienced in California, without collapse, but with some structural as well as nonstructural damage. In most structures, it is expected that structural damage, even in a major earthquake, could be limited to repairable damage. (Structural Engineers Association of California).

REF: California Joint Committee on Seismic Safety, 1974.

A SCALE OF ACCEPTABLE RISKS

Plate 7

6.13 Land-Use and Ordinance Review Programs

The results of detailed seismic and geologic investigations should be used to formulate a land-use plan based on the hazards present and the level of acceptable risk. High-hazard areas should, ideally, be devoted to open space uses; critical and high-use facilities should be located in as low a risk area as possible.

All pertinent local building codes and grading ordinances should be periodically reviewed and updated to reflect current state-of-the-art knowledge relating to seismic and geologic hazards. Consideration should be given to formulating and adopting more stringent codes and ordinances for structures in high risk areas. Structures currently in these high risk areas should be made to comply with the special risk zone coding or have their use restricted to an acceptable risk level.

6.1.4 Site Investigation Ordinances

Ordinances should be enacted requiring seismic, soil engineering and geologic studies for all proposed developments. Very detailed studies on developments in high risk areas and for major or sensitive structures should be outlined and required. These studies should be the responsibility of and be paid for by the developer. Qualified professionals should be retained to review and evaluate the completeness and accuracy of these predevelopment studies.

6.1.5 Hazardous Structures Abatement

The potential for seismically-induced structural damage is of major concern. The risk to life and property resulting from partial failure or collapse during earthquakes of buildings not designed in accordance with accepted standards exists in most cities in California. Therefore, techniques should

to identify substandard structures for abatement purposes. These techniques should be developed by a structural engineer with experience in the identification and correction of substandard structures. Consideration should be given to such factors as: the age and type of structures present, present use, and the seismic and geologic environment.

The elimination, renovation, or change in use of structures likely to sustain substantial damage during an earthquake is of prime importance. All major structures should be evaluated to determine their response to ground shaking and susceptibility to ground failure. Critical and high-use facilities, including police and fire stations, hospitals, public utilities, and public buildings, must remain functional in the event of a damaging earthquake. These facilities should have first priority on any structural abatement action.

The inspection program should be based on updated codes and ordinances. However, the inspection and mitigation of hazardous structures should not be postponed if updating of codes and ordinances is not soon to be undertaken.

6.1.6 New Building Inspection

During recent earthquakes, buildings supposedly designed to be earthquake resistant have failed under seismic forces, partially due to improper design and partially from poor quality materials and workmanship. Strict enforcement of existing building codes and better inspection procedures might have prevented some of these failures. Structural elements of all new major buildings should be continuously and closely inspected, and the quality of construction materials tested throughout all phases of construction. In addition, programs

should be initiated to keep inspectors aware of all changes or additions to the building code and advised of the acceptability of new design concepts and building practices.

6.1.7 Seismic Safety Review Board

It is suggested that a review board composed of qualified engineers, architects, geologists, seismologists, and planners be established to help formulate, direct, and then evaluate the results of the programs described above. The Board should have sufficient authority to ensure the successful enactment and execution of all seismic safety programs. In addition, the Board should periodically review and update the Seismic Safety Element to incorporate new data and to reflect the changes in the state of the art.

6.1.8 Structural Analysis

This element did not include consideration of the effects of ground shaking on structures. The following brief discussion is intended to present a very generalized summary of the factors that should be considered in evaluating earthquake effects on structures.

The type of existing structures and their design and construction are very important in evaluating the degree of risk associated with ground shaking. Older or substandard structures and multi-story, unreinforced masonry structures are most subject to shaking damage and present the highest risk to life and property. Structures built prior to 1933 can generally be considered to be more susceptible to damage from ground shaking than newer structures which have been designed in accordance with even rudimentary consideration of earthquake forces.

The effect of ground shaking on buildings is not limited to its impact on the integrity of the overall structure. Another, and possibly even greater risk

to life and property, is that associated with the contents of the building as well as exterior attachments. Ground shaking damage to parapets, marquees, and other exterior attachments can result without major structural damage. Similarly, the ground shaking effects on interior elements and fixtures can pose a very high risk, particularly to life. Falling objects, overturning of equipment or heavy furniture, inoperative elevators, and failure or clogging of stairways, can have disastrous effects - particularly in the event of fire. If such damage occurs in critical structures whose continued function is necessary following an earthquake, the subsequent risk to life and property is greatly increased. Fire fighting, medical, and other critical facilities are good examples of structures whose failure to remain functional would result in greater loss of life and increased property damage.

Although it is the intent of building codes and regulations to provide a reasonable measure of protection against ground shaking hazards, many older buildings in the City were doubtlessly constructed prior to the inclusion of these provisions in the codes. Also, some of the developed design and inspection procedures. Seismic and geologic investigations may also indicate that revisions and additions will be necessary to codes and ordinances to reduce risks to acceptable levels. Table 3, Hazard Comparison of Non-Earthquake Resistant Buildings, is a simplified description of various buildings (not containing earthquake bracing) and their susceptibility to damage as classified by the Pacific Fire Rating Bureau.

Note: This table is intended for buildings not containing earthquake bracing, and in general, is applicable to most older construction. Unfavorable foundation conditions and/or dangerous roof tanks can increase the earthquake hazard greatly.

Simplified Description of Structural Type	Relative Damageability (in order of increasing susceptibility to damage)
Small wood-frame structures, i.e., dwellings not over 3,000 sq. ft., and not over 3 stories.....	1
Single or multistory steel-frame buildings with concrete exterior walls, concrete floors, and concrete roof. Moderate wall openings.....	1.5
Single or multistory reinforced-concrete buildings with concrete exterior walls, concrete floors, and concrete roof. Moderate wall openings.....	2
Large area wood-frame buildings and other wood-frame buildings.	3 to 4
Single or multistory steel-frame buildings with unreinforced masonry exterior wall panels; concrete floors and concrete roof.	4
Single or multistory reinforced-concrete frame buildings with unreinforced masonry exterior wall panels, concrete floors and concrete roof.	5
Reinforced concrete bearing walls with supported floors and roof of any materials (usually wood).	5
Buildings with unreinforced brick masonry having sand-lime mortar; and with supported floors and roof of any materials (usually wood).	7 up
Bearing walls of unreinforced adobe, unreinforced hollow concrete block, or unreinforced hollow clay tile.	Collapse hazards in moderate shocks

REF: Steinbrugge, K.V., 1968, Earthquake hazard in the San Francisco Bay Area — A continuing problem in public policy; Institute of Governmental Studies, University of California, Berkeley, California, 80 p.

Table 3
HAZARD COMPARISON OF NON-EARTHQUAKE
RESISTANT BUILDINGS

6.2 POST-EARTHQUAKE ACTION

The period immediately following a major earthquake can range from complete chaos to the prompt and orderly implementation of disaster relief programs. What condition prevails during the period will depend largely on how well pre-earthquake programs were formulated and implemented and how efficient and well organized were the post-earthquake disaster plans and procedures. The post-earthquake period is the testing ground for the pre-earthquake plans and procedures. The 1971 San Fernando Earthquake provided valuable information on the effectiveness of disaster plans. The City of Los Angeles, Department of Building and Safety, had a plan in effect at the time of the earthquake which, although generally adequate, proved to be insufficient in some respects. Due to the loss of telephone communications, it was nearly 12 hours before the true magnitude and extent of the damage was known.

Once preliminary evaluation has been made of the type, amount and distribution of damage, emergency inspection of damaged buildings should be started. Critical structures should be inspected as soon as possible to ensure the continuation of like-line services. Inspection of other structures should then commence, with the most severely damaged reviewed first. Computer capability should be available for analysis and coordination. A provision should also be made in the inspection procedure for estimating dollar amounts of damage for use in obtaining federal disaster relief funds.

APPENDIX

Geologic Map, Plate 2

Sources:

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NOISE ELEMENT

1.0 INTRODUCTION

Noise can be defined as unwanted or expressive sound. In recent years there has been an increasing awareness of the importance of environmental noise; it can be annoying, it can interfere with sleep, work, and recreation, and in extreme cases it may cause physical or psychological damage.

In recognition of environmental noise problems, the California State Government Code requires a noise element of the general plan for all cities. The purpose of the noise element is to identify noise problems and outline a workable program to mitigate the effects of noise.

2.0 EXISTING ACOUSTIC CONDITIONS

2.1 NOISE MEASUREMENTS

In order to determine the existing noise climate in Emeryville and to characterize spatial and temporal variations, twenty-two sound level measurements were made. The measurements were made at various times of the day including morning, midday, afternoon and night. The measurement sites were chosen so as to represent a variety of land uses and zoning types including residential, commercial, industrial and open space areas. The measurements also included samples of train and helicopter noise.

The A-weighting network was used for all measurements. This network modifies sounds in the same way as the human ear does, and noise measured on this scale can be correlated well with human annoyance. The standard unit notation for sound levels weighted by an A network is dBA. The dBA unit is the one most commonly used in describing all types of community noise sources. In addition, most laws and ordinances pertaining to noise from highway and stationary sources are expressed in terms of dBA. Table 1 shows typical dBA levels for common noise sources.

Table 1 TYPICAL SOUND LEVELS FOR COMMON NOISE SOURCES IN dBA

Overall Quality	dBA	Outdoor	Indoor
Uncomfortably loud	130	50-horsepower siren at 100 feet	-
	120	Jet take-off at 200 feet	-
	110	-	Rock-n-roll band
Very loud	100	Jet flyover at 1000 feet, power mower	Newspaper press
	90	Motorcycle at 25 feet	Food blender
Moderately loud	80	High urban ambient sound; passenger car, 65 miles per hour at 25 feet	Garbage disposal, clothes washer
	70	-	TV audio, vacuum cleaner
	60	Air conditioner at 20 feet	Electric typewriter, conversation
Quiet	50	Light traffic at 100 feet	Average residence
	40	Bird calls, lower limit urban ambient sound	-
Very quiet	30	-	Soft whisper
Just audible	20	-	Television studio, leaves rustling
	10	-	-
Threshold of hearing	0	-	-

Source: Earth Metrics Inc.

Each sample was of 15 minute duration. This is considered to be a sufficient time period for a statistically valid representation of both constant noise and noise sources such as traffic streams. Total traffic volume and truck counts were noted, as well as vehicle speed estimates. The measurement sites are shown graphically on a map of Emeryville in Plate 1. The samples were analyzed to determine the levels exceeded 10, 50 and 90 percent of the time. These units are denoted as L₁₀, L₅₀, and L₉₀ respectively.

2.2 EXISTING NOISE FROM TRANSPORTATION SOURCES

Three of the major sources of noise in Emeryville are motor vehicle traffic, helicopter service, and railroad trains. These sources operate singly or in combination to affect the noise climate of the city.

The results of the measurements of traffic noise are shown in Table 2; a description of each site, the time period of the samples and the traffic counted are also shown with L₁₀, L₅₀ and L₉₀ in this table.

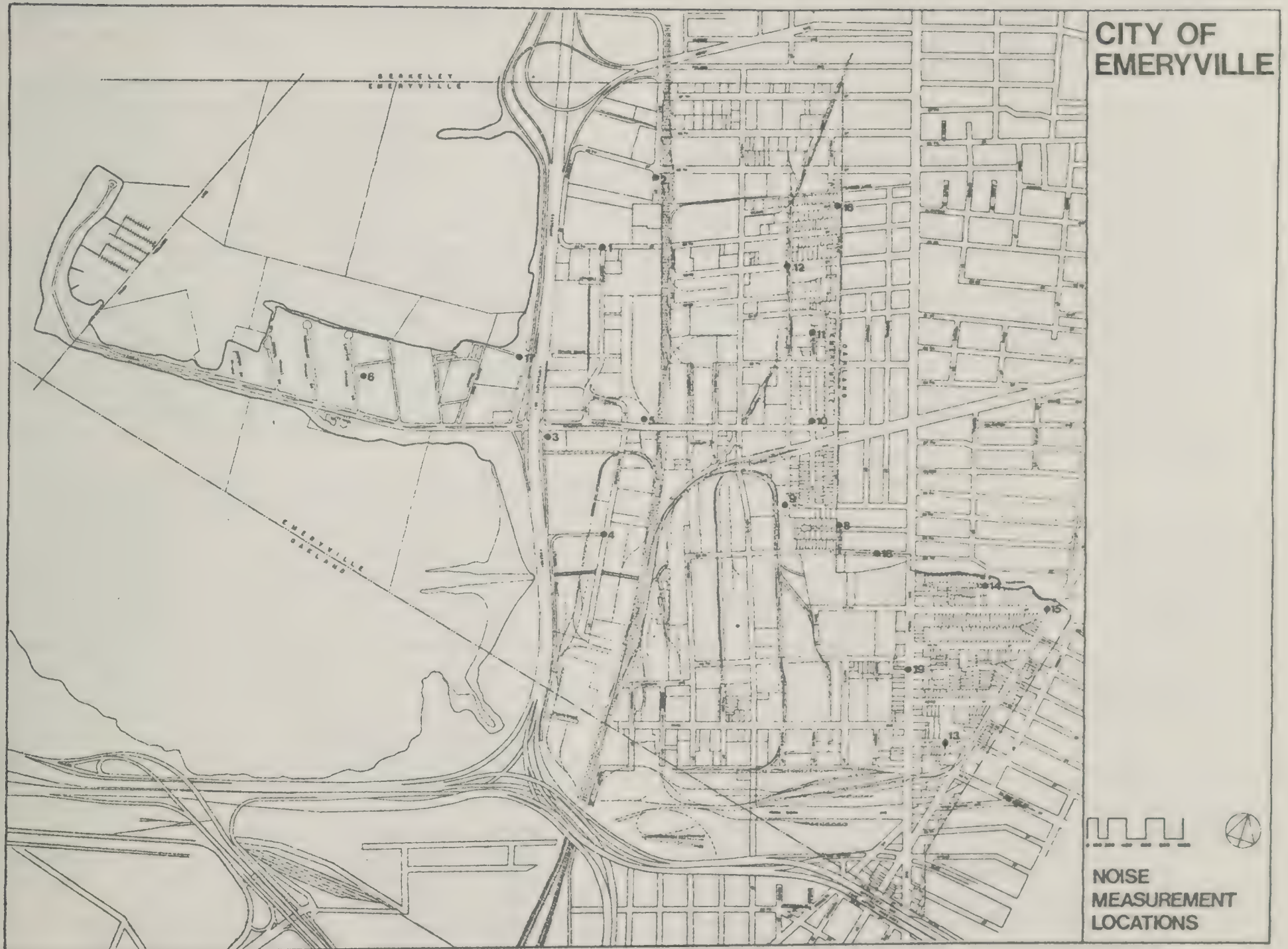
The intersection of Powell Street at the freeway was very noisy with an L₁₀ of 82 dBA. The noise contributing to this sample was traffic on Powell Street, the off-ramps at Powell and Interstate 80 itself (although traffic counted does not include 180 as it is elevated at this point). The residential neighborhood east of San Pablo Avenue between 41st and 48th Streets is being impacted by traffic on San Pablo Avenue as can be seen from the L₁₀'s from Sites 13 and 14 of 69 dBA and 66 dBA. Although these levels are much lower than the measurement taken near the freeway, they do represent an impact as they were taken in a residential area. The residential area on Doyle near Powell is also heavily impacted by roadway noise, as is evident from the measured L₁₀ of

Table 2 RESULTS FOR NOISE SAMPLES OF TRAFFIC SOURCES

Site Number	Site Description	Time	Traffic	L ₁₀	L ₅₀	L ₉₀
3	Powell and near-by off ramp	3:30 p.m.	703	82	77	73
5	Emeryville Market Parking Lot	1:35 p.m.	0	67	63	61
6	Watergate Parking Lot	1:50 p.m.	0	62	59	58
8	54th and Boyer	4:20 p.m.	6	61	54	52
10	Beaudry and Powell	12:40 p.m.	177	75	67	61
11	North end of Beaudry	6:30 p.m.	1	61	54	53
12	63rd and Doyle	12:15 p.m.	18	65	58	54
13	41st at School	5:45 p.m.	43	69	59	53
14	47th between San Pablo and Adeline	5:00 p.m.	55	66	58	53
15	Adeline at 46th	5:20 p.m.	153	72	65	60
16	Ocean and Vallejo	11:55 a.m.	23	64	55	53
17	Holiday Inn Parking Lot	3:00 p.m.	895	72	68	66
18	53rd between Boyer and San Pablo	4:40 p.m.	29	63	56	53
19	San Pablo between 43rd and 45th	6:00 p.m.	298	76	69	61

Note: If sample was taken at an intersection, traffic given is total volume of traffic entering intersection.

Source: Earth Metrics Inc.



75 dBA at Site 10. Noise levels in the areas described above are higher than the planning criteria which are set forth herein.

One noise measurement of a helicopter landing and taking off was obtained. It was taken in the parking lot of the Holiday Inn at approximately 45 meters from the helicopter (Site 17 in Figure 1). The heliport accommodates approximately 15 flights per day, one before 7:00 a.m. and none late at night. The measurement included the last portion of the landing, the idling of the helicopter on the landing pad and the take-off. The average noise during this period was 81 dBA while the peak noise noted was 87 dBA. It should be noted that the microphone was not in the take-off or landing path. Hence, the levels given are not the highest levels which could actually be measured at another location. The levels compare with those of construction noise, for instance, and can be considered to be relatively high.

A sample of train noise was obtained from approximately 12-15 meters in the parking lot of the Emeryville Market (Site 5 in Plate 1). The sample can be used to describe railroad noise in a residential neighborhood, as residential conditions were simulated. That is, the ambient noise measured after the train had passed was relatively low (L_{50} or average noise level measured at 63 dBA). The peak noise measured was 89 dBA while the average noise during the passage was 83 dBA. The frequency and times of day at which trains pass through Emeryville make these levels especially noteworthy. Currently 44 freight trains (average length of 5000 feet) and 6 passenger trains per day pass through the city. Their movement is not restricted to daytime hours. Each industry on the spur could average two train movements on a peak day. While the noise emitted from these trains during the day may be acceptable, it is definitely unacceptable at night (10 p.m. - 7 a.m.), especially where trains move directly through residential areas. The intermittent nature of the railroad noise makes it particularly disturbing at night.

Figure 2 shows noise contours for the measured train noise. The contours represent peak hour L_{10} levels. (An assumption was made that during a peak hour, three trains might pass).

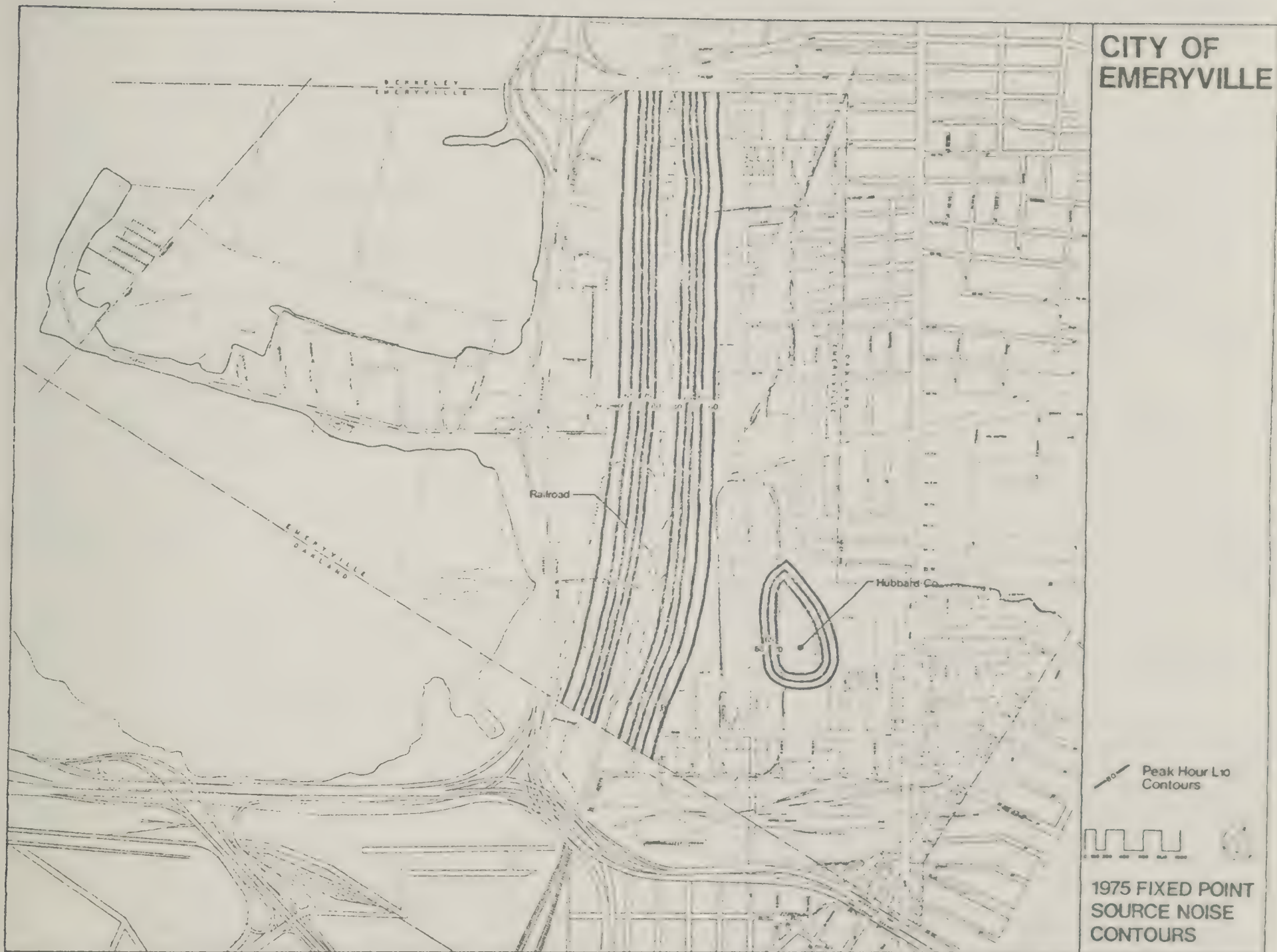
2.3 EXISTING NOISE FROM A FIXED POINT SOURCE

Industry is a major land use in Emeryville. For this reason, fixed point or stationary sources of noise are more common than in most communities. Table 3 shows the results of the sampling of noise from some of these sources.

One measurement was taken at 64th and Christie, located within Action Area 3 set forth in the General Plan. Most of the noise contributing to this sample was not from the nearby factories, but from truck movement in and out of the factories. In observed L_{10} of 75 dBA is relatively high but is acceptable for industrial land use. It would not, however, be acceptable for residential land use.

Two measurements were made outside the Hubbard and Company Plant at Doyle and 47th Street near Action Area 11. These measurements were used to develop noise contours (Plate 2) for the surrounding area. The contours do not reflect noise generated by Del Monte. In the growing season, Del Monte's contribution to the noise climate of the area is likely to be very significant, as they require extra truck and railroad traffic during that time.

The Hubbard Company Plant generates strong vibrations to the surrounding area as a result of a drop-hammer inside the plant. Should Action Area 10 be developed, these vibrations could be a source of annoyance in that area. As vibrations are not measurable with a noise level meter or noise classifier without an accelerometer attachment, it is recommended that accelerometer measurements be made to determine the extent and magnitude of the vibrations.



The samples taken at the remaining sites listed in Table 3 were found to be within the limits of acceptable noise.

3.0 FUTURE ACOUSTIC CONDITIONS

3.1 FUTURE NOISE FROM TRANSPORTATION SOURCES

For long planning purposed it is important to have an estimate of the future noise climate. Predicted contours of roadway noise for 1995 have been developed and are shown in Plate 3. As traffic volumes will be increasing over the next twenty years, noise levels from traffic sources will also increase. Predicted traffic volumes obtained from the State were used to make the predictions.

3.2 FUTURE NOISE FROM FIXED POINT SOURCES

For study of future noise from fixed point sources, it is assumed that the sources will be located as they are now. Of course, through the planning process this may be altered, in which case our results concerning future noise from stationary sources would need to be modified.

4.0 PLANNING CRITERIA AND NOISE PRODUCTION STANDARDS

In planning for a desired community noise climate two types of considerations are important. First, due to existing noise sources which are essentially fixed (such as freeways and railroads) certain areas may be unsuitable for some types of land use. It is therefore desirable to establish criteria for planning potentially acceptable land uses for a given site. Second, limits must be placed on the noise production of individual sources to ensure that noise levels within any given land

Table 3 RESULTS FOR NOISE SAMPLES OF FIXED POINT SOURCES

Site Number	Site Description	Time	L ₁₀	L ₅₀	L ₉₀
1	64th and Christie	11:10 a.m.	75	64	60
2	Bay, south of 65th	11:30 a.m.	64	58	53
4	Shellmound, south of 65th	6:50 p.m.	64	56	53
7	Doyle and 47th	4:00 p.m.	69	64	63
7	Doyle and 47th	9:30 p.m.	64	60	57
9	Doyle and 55th	1:00 p.m.	63	54	53

Source: Earth Metrics Inc.

use remain within some recommended range. Specific noise levels which may be employed as planning criteria and as noise production standards are presented in this section.

4.1 AMBIENT LAND USE PLANNING CRITERIA

In order to protect the acoustical environment, appropriate to each land use class and activity type, the noise levels suitable to residential, commercial and industrial uses are given in Tables 4 and 5. These criteria may be invoked for the following purposes:

- a. to determine the suitability of lands to be developed considered as a receptor to which the standards apply
- b. to determine the suitability of building types and proposed construction materials to be applied on the site

4.2 NOISE EMISSION STANDARDS

The noise emission standards for construction equipment listed in Table 6 are applicable to the named source whether operated by individuals, companies, public agencies or other organizations. Table 7 shows State standards for motor vehicles operating on public roadways. In addition, the State has set standards for new vehicles at the time of sale.

In addition to these specific standards, the following general standard should be met:

No person shall be allowed to cause any noise to be emitted in any manner so as to create any noise which would cause the noise level at the property line of any property to exceed the ambient base noise level by more than 5 dBA.

Table 4 AMBIENT LAND-USE PLANNING CRITERIA

Zone	Maximum Outdoor Noise Level (dBA)			
	L ₅₀		L ₁₀	
	Day (7 a.m.-10 p.m.)	Night (10 p.m.-7 a.m.)	Day (7 a.m.-10 p.m.)	Night (10 p.m.-7 a.m.)
Residential	55	50	60	55
Commercial	65	60	70	60
Industrial	70	65	75	75

Source: Earth Metrics Inc.

Table 5 INDOOR PLANNING CRITERIA

Zone	Maximum Indoor Noise Level (dBA)			
	L ₅₀		L ₁₀	
	Day (7 a.m.-10 p.m.)	Night (10 p.m.-7 a.m.)	Day (7 a.m.-10 p.m.)	Night (10 p.m.-7 a.m.)
Residential	45	40	50	45
Commercial	55	50	60	60
Industrial*	60	60	65	65

* Indoor industrial standards are set by the Occupational Safety and Health Administration

Source: Earth Metrics Inc.

Table 6 MAXIMUM ALLOWABLE NOISE LEVELS FROM CONSTRUCTION EQUIPMENT

Equipment	Peak Noise Level in dBA at 50 ft.
Earthmoving	
front loader	75
backhoes	75
dozers	75
tractors	75
scrapers	80
graders	75
truck	75
paver	80
Materials Handling	
concrete mixer	75
concrete pump	75
crane	75
derrick	75
Stationary	
pumps	75
generators	75
compressors	75
Impact	
pile drivers	95
jackhammers	75
rock drills	80
pneumatic tools	80
Other	
saws	75
vibrator	75

Source: Earth Metrics Inc.

Table 7 CALIFORNIA STATE NOISE STANDARDS FOR MOTOR VEHICLES (at 50 feet from center lane of travel).

	35 mph	35 mph
Trucks*	88	90
Motorcycles	82	86
Automobiles	76	82

*For trucks manufactured after 1973, and operating at 35 mph or less, the maximum level allowed is 86 dBA.

Note: Trucks are defined to be "Any motor vehicle with a manufacturer's gross vehicle weight of 6000 lbs. or more, and any combination of vehicles towed by such motor vehicles".

Motorcycles are defined to be "Any motorcycle other than a motor driven cycle".

Automobiles are defined to be "Any other motor vehicle and any combination of vehicles towed by such motor vehicle".

Source: Earth Metrics Inc.

For the purposes of this standard, ambient noise level is defined to be the higher of 1) the L_{10} level measured at the site over the hour in question, or 2) the planning criteria noise level for the receptor land use in question (these levels will be slightly higher in Emeryville than in some other communities, as the ambient noise in Emeryville is relatively high).

These standards may be invoked for the following purposes:

- To regulate any noise source (other than aircraft and motor vehicles operating on public thoroughfares) which cause violation of the standards
- to determine the suitability of land to be developed considered as a noise source with nearby properties considered as receptors to which the standards apply

5.0 NOISE IMPROVEMENT AREAS

5.1 GENERAL

The purpose of this section is to identify those areas in Emeryville which need noise improvement. In general, areas requiring noise improvement incur existing and future noise levels which exceed the recommended noise standards discussed in Section 4.0. The areas requiring noise improvement are described by Action Area below. Please refer to the Action Area Map on page 14 of the Phase I General Plan Report.

5.2 NOISE IMPROVEMENT AREAS

5.2.1 Baylands, West of Eastshore Freeway, Action Area 4

This area has been designated for mixed use including residential land use in the future. In order to meet suggested noise criteria for residential land use, abatement measures would probably need to be undertaken, as the adjacent freeway and heliport will have a noise impact, especially on homes nearest to them. Since this area is being considered for mixed commercial and residential use, a possible planning strategy to minimize noise problems might be to plan for commercial land use nearest the freeway and heliport, and to plan the west and north sections of the parcel as the residential area. The landing and take-off path for the heliport should be carefully chosen so as to least impact the nearby restaurant, hotel and apartments as well as the planned commercial and residential development.

5.2.2 The Shell Parking Lot and AC Transit Depot, Action Area 10

This area is also designated for mixed use including residential land use in the future. Although the noise contours developed in Plate 2 do not show the area in question to be seriously impacted, it must

also be remembered that production of noise from Del Monte has not been included in those contours. As explained in previously the contribution of Del Monte to the noise climate of the area is probably very significant, especially in the growing season. The existing industries, plus the traffic noise impact of San Pablo Avenue on the eastern portion of the parcel probably make it unsuitable for residential land use without abatement measures.

5.2.3 Residential Area East of San Pablo, Action Area 11

Currently and in the future this residential neighborhood will be impacted by traffic noise generated on San Pablo Avenue. A number of measures could be taken to mitigate the effect of the noise impact in order to make this area suitable as a residential neighborhood. These include the use of concrete barriers and special noise insulation of buildings. Since it is impractical to place a barrier along the entire length of San Pablo Avenue, it is expected that a barrier would be built around any development off of San Pablo impacted by adverse noise conditions. These and other measures to mitigate noise are discussed further in the following section.

6.0 NOISE MITIGATION MEASURES

6.1 BARRIERS

The most successful method of abating noise is the use of solid dense walls, 10 to 12 feet high as sound barriers near major sources of noise. Reduction of up to 15 dBA are obtained with relatively high barriers. However, although the path of the sound wave is blocked, the problem of noise is not completely eliminated as the sound waves diffract around the

barrier. The amount the noise is reduced depends on the distance from the source to the barrier, on the distance between the barrier and the receiver, and the heights of the source, the barrier and the receiver.

Table 8 shows the results of tests performed to evaluate the effectiveness of barriers. As can be seen, solid walls are effective in reducing noise levels. Table 9 indicates reductions obtained by barriers of different heights.

Table 8 NOISE REDUCTION OF BARRIERS

Type of Barrier	Noise Reduction (10' Directly Behind Barrier)
Brick 6' x 3"	10 dBA
Concrete Block 6' x 8"	11 dBA
Masonry Block 8' x 6"	12 dBA
Concrete 8' x 6"	13 dBA

Source: Earth Metrics Inc.

Table 9 MAXIMUM NOISE REDUCTION FROM BARRIERS OF DIFFERENT HEIGHTS

Observer Distance from Barrier (feet)	Height of Barrier (feet)	
	6 feet	12 feet
10'	15 dBA	15 dBA
50'	10 dBA	15 dBA
100'	7 dBA	13 dBA

Source: Earth Metrics Inc.

6.2 LANDSCAPING

Although little detailed research has been performed on the ability of landscaping to alleviate sound, previous studies have indicated that landscaping, both trees and ground cover, may reduce noise levels by as much as 7 decibels per 100 feet of planting depth, and "soft" surfaces such as lawns or other ground covers absorb sound, as opposed to "hard" surfaces such as parking lots, which may amplify noise levels by reflection. Studies also have indicated that "buffer" planting strips may have a psychological influence that noises are being "reduced."

For specific application of roadside landscaping refer to the Scenic Highway Element.

6.3 CONSTRUCTION STANDARDS

Noise levels also may be reduced by the type of construction and planning required. For example, double glazing on windows may reduce noise levels substantially (up to 15 dBA) and outdoor spaces may be shielded from the noise source to make them less noisy and more livable.

7.0 NOISE ABATEMENT PROGRAM

A program of noise abatement and control is needed to implement the standards presented herein. The program makes use of established city procedures and are summarized as follows:

7.1 NOISE ORDINANCE

The City should prepare a noise ordinance presenting methods of determining compliance

with standards and enforcing these standards. Various model noise ordinances were reviewed. The one developed by the California League of Cities and implemented by numerous cities appears to be a reasonable approach for Emeryville.

7.2 ENFORCEMENT OF THE NOISE ORDINANCE

Essential to enforcement of the suggested Noise Ordinance is the establishment of a Noise Enforcement Officer, preferably a member of the police force. His task is to investigate possible violations of the city noise ordinance and to write citations where violations are found. The duties of the Noise Enforcement Officer demand a basic understanding of noise and the ability to operate and calibrate a noise level meter. It is recommended that the city purchase a hand-held noise meter with the precision microphone type 4148 for enforcement purposes. Ideally, at least one police officer per shift should be trained to fulfill the measurement responsibilities of the Noise Enforcement Officer.

When investigating a possible noise violation, the enforcement officer, having first calibrated the noise level meter, shall measure the ambient noise for a period of 15 minutes using the A-weighted scale. The officer shall record the average noise levels for every 10 seconds of the measurement period, discounting noises from the possible violator. A second measurement is taken, this time including the noise source under investigation. If the officer finds a difference of 5 dBA or more, between the two measurements, he shall write a citation. It may be necessary for the officer to request that the noise source to be interrupted or turned off in order to take an accurate ambient measurement.

7.3 ENVIRONMENTAL IMPACT REPORT

In determining the need to produce an Environmental Impact Report pursuant to requirements of the California Environmental Quality Act (CEQA), the city staff

should follow these guidelines for determining whether significant potential acoustic impacts may arise from the project. These guidelines are derivative from the noise standards, noise ordinance and the applicability of CEQA to uphold local environmental standards.

7.4 IMPLEMENTING THE CALIFORNIA STATE UNIFORM BUILDING CODE ACOUSTICAL CLEARANCES

As an integral part of the building permit system, the following procedure is recommended for implementation by the city staff. Initiation of the program requires the city to appoint a member of the city staff to administer the acoustical review process which could include review of the noise elements of the Environmental Impact Statement. Hereafter, the term "city staff" is used to denote such an administrator. One of his functions is also to determine one or more companies qualified to perform acoustical review functions until such time as the city may have field measurement equipment, trained field personnel, and an operational noise propagation model.

SAFETY ELEMENT

1.0 INTRODUCTION

The purpose of the Safety Element is to insure that health and welfare considerations have been introduced into the long range planning process. Its particular focus is to reduce the potential loss of life, injuries, property damage, and dislocation due to fires, floods and other natural disasters.

Natural conditions that will affect the Safety Element in the City of Emeryville are primarily flooding and earthquakes. The seismic analysis has been discussed in the Seismic Safety Element and the principle conclusions of the analysis as they pertain to the Safety Element are included in that element.

2.0 FLOODING

Emeryville has had a history of flooding and erosion on Temescal Creek which over the years has caused the loss of many thousands of dollars of property damage. The major damaging flood of October 1962 in Emeryville and Oakland prompted the Alameda County Board of Supervisors in January 1963 to establish Zone Number 12 of the Alameda County Flood Control and Water Conservation District. Since the establishment of Zone Number 12 Temescal Creek, the major drainage course, has been improved from San Francisco Bay to Adeline Street. The Creek is now capable of conveying the runoff from a 100 year storm.

The federal government under the auspices of the U.S. Department of Housing and Urban Development is requiring the mandatory involvement of local governments in the Federal Flood Protection Program as requires by 1973 Flood Disaster Protection Act. In this program, local communities located in flood prone areas must participate in order to qualify for any federal funding. Emeryville is participating in this program.

3.0 CIVIL DEFENSE AND DISASTER PLANNING

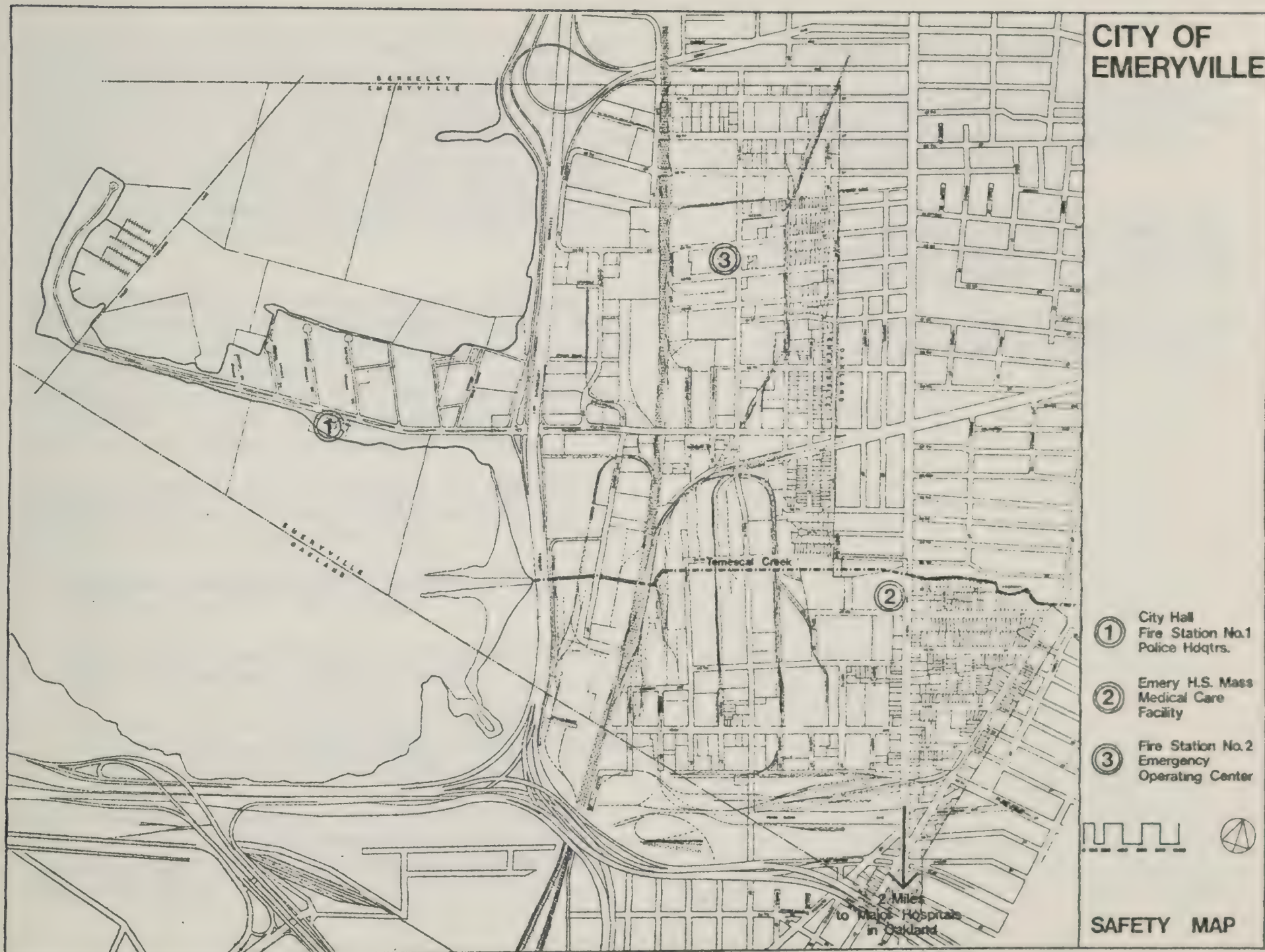
Civil defense and disaster preparedness are the responsibility of the City of Emeryville. The City coordinates its programs with Federal, State, and County respective offices of Emergency Services.

Under the mandate of the California Emergency Act of 1970, the City Council adopted an Emergency Operations Plan on July, 1966 which was subsequently revised on August, 1972. This Plan provides for the deployment of public and private resources to cope with a wide range of emergency situations. The specific purposes of the Plan are set forth as follows:

1. Provide a basis for the conduct and coordination of operations and the management of critical resources during emergencies;
2. Establish a mutual understanding of the authority, responsibilities, functions, and operations of civil government during emergencies;
3. Provide a basis for incorporating into the City emergency organization non-governmental agencies and organizations having resources necessary to meet unforeseeable emergency requirements.

Emergency medical facilities are coordinated by Alameda County Medical Health Care Services. A Medical Alert Plan was prepared in 1972 which describes health care actions to be taken in case of an emergency.

Under the California Dam Safety Act of 1972, the state has mandated that local governments prepare a Dam Evacuation Plan for localities that may be inundated due to a dam failure.



Emeryville may be subject to flooding by failure of Lake Temescal Dam and Reservoir. The potential risk must be identified by the State Department of Water Resources in conjunction with the operator of the facility, in this case the East Bay Municipal Utility District. Currently the dam failure risks of this facility have not been investigated. However, since the capacity of Lake Temescal Reservoir is only 165 acre feet, the potential hazard for Emeryville is negligible.

The City of Emeryville is currently preparing an Earthquake Response Plan, the purpose of which is to describe the emergency actions to be taken in case of a major damaging earthquake. The basic directive of this Plan was prepared by the Alameda County Office of Emergency Services in coordination with a directive issued by the federal office of Civil Defense.

The Safety Map, Plate, 1, indicates the location of emergency service facilities within and adjacent to the City of Emeryville. They are:

1. Emergency Operating Center located at Fire Station #2 at 63rd and Hollis.
2. Mass Medical Care Emergency Assistance Center at Emery High School, 1100 47th Street.
3. Medical Alert Point for Northern General Region of Alameda County Medical Health Care Facilities at Peralta Hospital, 450 30th St. Oakland.

Until a state of emergency is declared, emergency operations will be headquartered in the City Hall, (including Fire Station #1 and Police Headquarters) 2449 Powell St.

4.0 RECOMMENDED SAFETY PROGRAMS

1. Conduct a yearly drill of the Emergency Operations Plan to familiarize local staff and citizenry with the procedures to be taken in case of emergency.
2. Revise the Emergency Operations Plan to include additional mandated annexes. The County Office of Emergency Services plans to assist in this update during mid-1975.
3. Complete the Earthquake Response Plan and disseminate the proposed action to local citizens.

SCENIC HIGHWAY ELEMENT

1.0 INTRODUCTION

The Scenic Highway Element provides Emeryville with a plan for the preservation and enhancement of the City's visually distinctive roadways and associated scenic corridors which surround them. An additional purpose of the Scenic Highway Element is to promote and project a positive visual image of Emeryville which serves to identify the City to travelers to and through the area.

The Scenic Highway Element must be considered in the context of the other General Plan Elements and is not intended to stand alone. The related elements are; Circulation, Land Use, Open Space and Conservation and Noise.

Emeryville's Scenic Highway Element is not seeking official scenic highway designation of any state routes located in the City limits by the State Scenic Highway Committee. The two functions of this Element are designation of local routes as "scenic" or visually important and development of specific beautification and conservation measures.

2.0 SCENIC RESOURCES

Emeryville's scenic resources were identified through a three step process which included review of existing scenic studies, interviews with city staff and field surveys. The survey included an extensive photographic record of both the City's visual assets and liabilities.

Emeryville's major visual resources are its views of San Francisco Bay the Oakland Hills, and the San Francisco and Oakland skylines. Views of these resources can be embraced from nearly any location in Emeryville

3.0 RECOMMENDED SCENIC HIGHWAY DEVELOPMENT PLAN

The recommended scenic highways plan is illustrated on the Scenic Highways Map, Plate 1. The map designates those routes which should receive special treatment. Specific recommendations are associated with each route and special scenic features as follows:

3.1 GATEWAYS

A gateway may be defined as an important visual entrance to a city or place. The intersection of the Eastshore Freeway and the approach ramps to the San Francisco Bay Bridge located on City's southern boundry is a major gateway to Emeryville. Other gateways one: Powell Street, San Pablo Avenue, from the intersection Adeline Street, and MacArthur Boulevard.

Traffic volumes indicate that many thousands of persons and consequently "viewers" pass through these gateways and therefore should be given first priortiy for scenic treatment.

The majority of the land available for beautification in these areas is under the jurisdiction of CALTRANS. CALTRANS is obligated by the State to landscape and maintain freeways. CALTRANS has recently completed landscaping at the Powell Street intersection.

Plans to beautify the major City gateways should be developed in full coordination with CALTRANS. The focal point of the major gateway beautification should be the development of new lighted signs which welcome the traveler to the City and identify the City by name and logo.

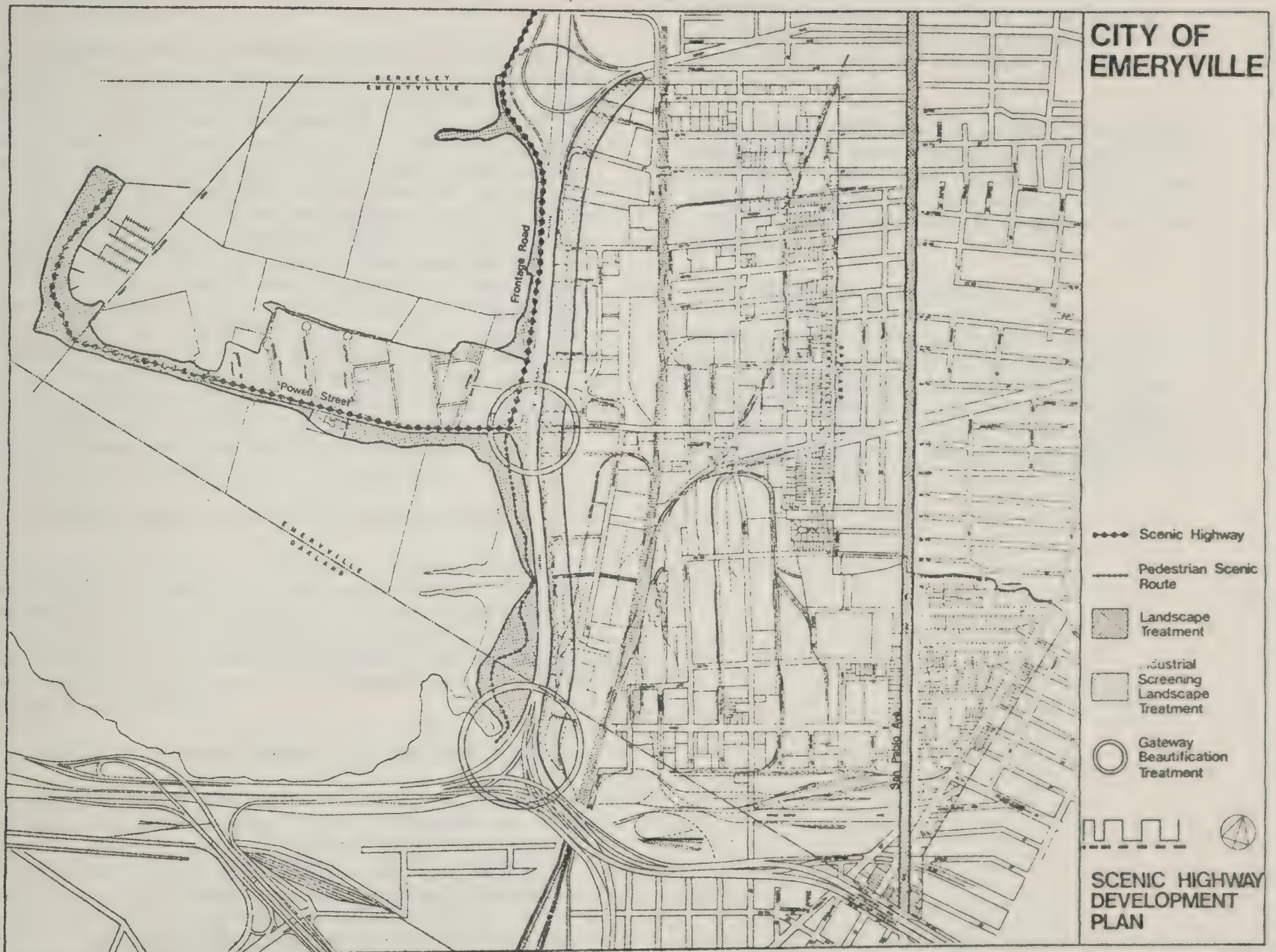


Plate 1

3.2 FRONTAGE ROAD

The Frontage Road is located between the edge of the Bay and Eastshore Freeway. This road offers splendid views of the San Francisco Skyline, Golden Gate Bridge, and Marin Headlands. The Emeryville Circulation Element, City of Oakland General Plan, BART Trails Study and the East Bay Regional Park District have recommended that the Frontage Road be improved to include a portion of a pedestrian and bikeway trail along the periphery of the Bay linking Oakland, Emeryville and Berkeley waterfronts'. It is recommended that the Frontage Road be designated for scenic treatment and that a specific Scenic Corridor Study be undertaken. Major tasks of that study would be the siting of pedestrian and bike paths, a landscape plan to buffer the Eastshore Freeway and architectural design of scenic turnouts and recreation areas. The corridor study should also consider pathways along the Bay-shore between the Oakland City Limits and Powell Street integrated with the Frontage Road.

3.3 POWELL STREET WEST OF THE EASTSHORE FREEWAY

This portion of Powell Street is located on the Emeryville Peninsula. The median is currently landscaped in an attractive manner, but no improvement of the south shoreline has been attempted. Pedestrian and bicycle paths should be provided, and the shoreline strip should be landscaped with emphasis given to improved fishing areas.

3.4 SAN PABLO AVENUE BETWEEN 41ST AND 53RD STREETS

Currently this portion of San Pablo Avenue is characterized as an unattractive, heavily traveled six lane arterial which presents a barrier separating Emeryville's residential neighborhoods located east and west of San Pablo Avenue. Efforts should be made to soften the visually obtrusive quality of this road. Special consideration should be given to median and

sidewalk landscaping and the introduction of different street paving at principal intersections to indicate potential neighborhood linkage.

Landscaping will provide a visual and psychological relief from the adverse noise impacts generated on San Pablo Avenue. Refer to the Noise Element for further details of application of landscaping to mitigate noise problems.

3.5 INDUSTRIAL SCREENING

Where possible, unsightly industrial areas and storage yards should be landscaped to screen unsightly views. Landscaping on the Eastshore Freeway was introduced for this purpose; However, in some places landscaping is not significantly dense to satisfy the intended function.

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The Honorable Doyle S. Hudson

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Noise Element Technical Study

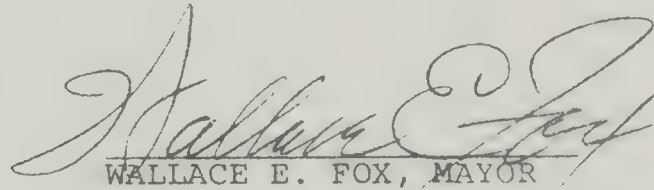
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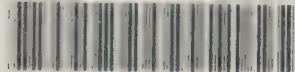
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